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Instrument-based vision-screening methods for refractive errors

Métodos de rastreamento de erros refracionais baseados em equipamentos

Métodos de rastreo de errores refractivos basados en equipos

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ABSTRACT

Uncorrected refractive errors are the main cause of decreases in visual acuity, and after cataracts, they are the second most important cause of blindness. In Brazil, most of the population lacks access to ophthalmology services and treatments; therefore, vision-screening programs are fundamental. Instrument-based vision screening is fast, does not depend on behavioral responses, requires minimal cooperation on the part of children, and is particularly useful for children in the pre-verbal phase, children who can't read, and children with developmental delays. Vision-screening methods to determine refractive errors using instruments (such as portable autorefractors and photoscreeners) may be used to examine children aged between 6 months and 3 years, as well as older children with disabilities or children who do not respond well to Teller visual acuity cards. As a whole, these methods identify the presence of optical and anatomical abnormalities, as well as risk factors for amblyopia, and estimate their magnitude. The use of this new technology is highly dependent on third-party payment policies, which may create a significant barrier to its implementation.

Keywords:
Vision-screening programs.
Ophthalmological diagnostic techniques.
Children.
Ocular refraction.
Amblyopia.

RESUMO

Os erros de refração não corrigidos são a principal causa de baixa de visão e, depois da catarata, é a segunda mais importante causa de cegueira. No Brasil a maioria da população não tem acesso a serviços oftalmológicos e tratamentos, sendo fundamentais os programas de triagem ou rastreamento visual. Triagem baseada em instrumento é rápida, não é dependente de respostas comportamentais, requer cooperação mínima da criança e é especialmente útil para crianças na fase pré-verbal, analfabetos ou com atraso de desenvolvimento. Os métodos de rastreamento de erros refracionais baseados em instrumentos (autorrefratores portáteis e photoscreeners) podem ser empregados em exames de crianças com idades entre seis meses e três anos e crianças mais velhas com incapacidades ou não responsivas à apresentação dos cartões de acuidade visual. Esses métodos, comumente, identificam a presença e estimam a magnitude de anormalidades ópticas e anatômicas dos olhos, e fatores de risco para a ambliopia. A adoção dessa nova tecnologia é altamente dependente de políticas de pagamento a terceiros, o que pode representar uma barreira significativa para adoção.

Palavras-chave:
Programas de Rastreamento.
Técnicas de Diagnóstico Oftalmológico.
Crianças.
Refração Ocular.
Ambliopia.

RESUMEN

Los errores de refracción no corregidos son la principal causa de baja de visión y, después de la catarata, es la segunda más importante causa de ceguera. En Brasil, la gran parte de la población no tiene acceso a servicios oftalmológicos y tratamientos, razón por la que son fundamentales los programas de clasificación o rastreo visual. La clasificación basada en instrumentos es rápida, no depende de respuestas comportamentales, requiere una cooperación mínima del niño y es especialmente útil para niños en la fase pre-verbal, analfabetos o con retraso en su desarrollo. Los métodos de rastreo de errores refractivos basados en instrumentos (autorrefractores portátiles y photoscreeners) pueden ser empleados en análisis de niños entre seis meses y tres años de edad, y niños mayores con incapacidades o no responsivos a la presentación de las tarjetas de acuidad visual. Esos métodos, comúnmente, identifican la presencia y estiman la magnitud de anormalidades ópticas y anatómicas de los ojos, y factores de riesgo para a ambliopía. La adopción de esa nueva tecnología depende altamente de políticas de pago a terceros, lo que puede representar una barrera significativa a su adopción.

Palabras clave:
Programas de Rastreo.
Técnicas de Diagnóstico Oftalmológico.
Niños.
Refracción Ocular.
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INTRODUCTION

The World Health Organization estimates that there are approximately 314 million people worldwide with visual impairments caused by disease and/or uncorrected refractive errors. At least 13 million children aged between 5 and 15 years and 45 million people aged between 16 and 49 years are affected by uncorrected refractive errors. These numbers do not include uncorrected presbyopia, the prevalence of which is unknown[1]. Therefore, uncorrected refractive errors are the main cause of decreases in visual acuity and the second most common cause of blindness after cataracts[2].

In Brazil, a significant portion of the population lacks access to ophthalmological services and treatments; therefore, vision-screening programs are fundamental. A study of the community and the specificities of each age group to enable the correction of refractive errors is crucial for economically, medically, and socially viable planning.

VISION-SCREENING METHODS FOR REFRACTIVE ERRORS IN PATIENTS AGED BETWEEN 0 AND 6 YEARS

The significant benefit of vision screening for refractive errors in this age group is the early detection of low visual acuity and/or risk factors that may compromise visual development (such as amblyopia, strabismus, significant refractive errors, and congenital cataracts).

It is estimated that 2% of children aged between 1 and 3 years present with refractive errors that require correction with glasses[3].

The success of vision-screening methods that use Teller visual acuity cards mainly depends on the child's age and the examiner's experience. Few professionals are trained to perform complete eye exams on children younger than 3 years. As a result, the strategy employed in social projects to detect amblyopia risk factors in pre-verbal children has been to use instrument-based vision-screening methods (such as portable autorefractors and photoscreeners) for identifying refractive errors[4].

Instrument-based vision screening is fast, does not depend on behavioral responses, requires minimal cooperation on the part of the children, and is particularly useful for pre-verbal children, children who can't read, and children with developmental delays. These methods typically identify the presence and magnitude of optical and physical anomalies of the eye; a printed copy or digital file is produced for inclusion in the patient's medical records.

Photoscreeners use optical images of the eye’s red reflex test to estimate refractive errors, cloudy media, ocular alignment, and other factors such as adnexal abnormalities (e.g., blepharoptosis) and those which put children at risk for developing amblyopia.

The autorefractor is another instrument that can be used for vision screening for refractive errors in children. It was designed to detect myopia, hyperopia, and astigmatism (including its axis) at 0.25-D increments (which can be changed to 0.12-D increments). The instrument is portable and easy to use, and objective automated refractometry is performed at a distance of 35 cm from the child who is being examined.

In a recent study, Arnold and Armitage[5] evaluated children who were consecutively seen in a pediatric ophthalmology clinic and who then underwent complete eye examinations in which four photoscreeners, PlusoptiX, SPOT, iScreen, and GoCheckKids, were used for the iPhone 4s with Delta Center Crescent interpretation. The study population included 108 children aged between 1 and 12 years; 58% of them presented with risk factors for amblyopia, and 10% were autistic. The four instruments produced different degrees of sensitivity, specificity, and inconclusive results, which were found to be as follows: PlusoptiX (83%, 86%, 23%, respectively), SPOT (80%, 85%, 4%, respectively), iScreen (75%, 88%, 13%, respectively), iScreen with Delta Center Crescent interpretation (92%, 88%, 0%, respectively), and GoCheckKids with Delta Center Crescent interpretation (81%, 91%, 3%, respectively). The authors concluded that all four photoscreeners were able to identify risk factors for amblyopia in young children.

VISION-SCREENING METHODS FOR REFRACTIVE ERRORS IN PATIENTS AGED BETWEEN 7 AND 14 YEARS

Vision screening using eye charts for examinations in this age group (elementary-aged and middle-school-aged children) aims to detect vision problems caused by uncorrected refractive errors and other ocular disorders.

Visual acuity measurements can be performed as a part of community-based campaigns by trained teachers at the schools. This screening should be annually performed, and cases presenting with risk factors should be sent for an eye examination by an ophthalmologist. High-quality and esthetically pleasing eyeglasses should be guaranteed in order to increase treatment compliance. It is

also important for teachers to monitor children's usage of eyeglasses, as well as the effect that the glasses have on their school performance.

Campaigns are often the children's first opportunity to receive an eye examination, and the participation of schoolchildren in these projects has varied between 67.8% and 94.2%[6,7,8]. Despite the offer of a free eye examination, high absence rates have been observed in these projects (31.3%–68.7%)[6]. One of the reasons may be the need to send the children screened by their teachers at school to receive an eye examination at a different place and on a different day.

Photoscreeners are compact, easy to use, and portable. Vision screening for refractive errors using these instruments may be performed at the child's school, an option which reduces the rate of absence.

VISION-SCREENING METHODS FOR REFRACTIVE ERRORS IN PATIENTS AGED 15 YEARS OR OLDER

Among patients aged 15 years or older, photoscreeners (such as the SPOT Vision ScreenerTM by PediaVision, the PlusoptiX S09TM, and the Near-Eye Tool for Refractive Assessment or NETRA) may be used during vision-screening campaigns for refractive errors in populations that do not have consistent access to ocular health services. The use of these instruments is a viable new option; when combined with telemedicine, it may increase this population's access to these ophthalmological services.

BARRIERS TO THE USE OF VISION-SCREENING INSTRUMENTS FOR IDENTIFYING REFRACTIVE ERRORS

Although all of the previously mentioned instruments are available for primary care services, they involve substantial expenditure for the primary care system. In addition to the costs of printers and ink cartridges, there are indirect costs, including personal time and space to perform these tests, as well as the time required for interpreting the results. The investment of capital for acquiring these instruments may be reduced if suppliers offer a leasing option as an alternative to purchasing the instruments; these costs should be calculated as part of the total costs of performing the test[4].

Regardless of the type of photoscreening or autorefraction system used, the examiner should know the limitations of the test and how to apply the technology.

FINAL CONSIDERATIONS

The use of photoscreening equipment and portable autorefractors allows improved vision screening for refractive errors in pre-verbal children, children who cannot read, and children with delays in neurological, psychological, or motor skill development. Children aged between 6 months and 3 years benefit from the use of these instruments for vision-screening processes, which allow the early detection of conditions that may lead to amblyopia. Among children aged between 3 and 5 years, the use of this vision-screening equipment for identifying refractive errors is considered a good alternative to screening that relies on Teller visual acuity cards. In children aged 5 years or older, the use of these instruments was not found to be better than the vision-screening tests performed using eye charts.

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